General Seed Transfer Guidelines for Washington

1. These guidelines only apply when planting on sites where the species naturally occurs within the seed zones.

2. Seed mixes should include seed from a number of different random locations within the tree seed zone and elevation band. If seed mixes are comprised of collections made only at one edge of a zone or only at one limit of an elevation band, a safe transfer might be about half a band width (either geographic distance or elevation) . Usually, this restriction would be more important for elevational and longitudinal transfers than for latitudinal transfers (Frank Sorensen, personal communication, March 1995).

3. Seed transfer to a higher elevation usually increases the risk of maladaptation; in other words, the potential for climatic damage. A transfer to a lower elevation will probably decrease productivity and may increase the risk associated with pest damage. If wood production is important and geographically localized collections are made, seed should probably not be transferred down to another elevation band.

4. Except for areas right along the coast, elevation does not have as great an influence as longitude for species on the west side of the Cascades. Latitude has less influence on seed transfer than longitude (Campbell and Sugano 1993, Campbell 1986, Sorensen 1983, and Campbell 1992).

5. Local populations are generally well adapted to local environments and are the safest to use until the best adapted, or better growing sources can be identified with data from long-term provenance tests (Namkoong 1969). This is particularly true for areas where large changes in the environment can occur over short distances, such as the islands in Puget Sound.

6. A seedling's response to its planting environment is significantly influenced by its parents' location (Campbell 1992).

7. Seed transfer zones should generally be smaller at high elevation than at low elevation (Campbell and Sorensen 1978). The size of seed transfer zones should decrease as site severity increases (Adams and Campbell 1982, Sorensen 1979). Therefore, less seed movement is possible at higher elevation Cascades sites. The steeper the genetic gradient and the harsher the planting site involved, the greater the risk of seed transfer (Adams and Campbell 1982). High elevations and harsh climates dictate that seed must be planted fairly close to its origin. However, close to the ocean at low elevation, seed movement becomes much less restrictive. The coastal climate permits most seed sources to survive, but those from harsher environments will grow much less than those from favorable environments which are better able to utilize the site potential.

8. When planting a species near its biological limits, a higher planting density is recommended and early thinning should be delayed to compensate for higher than normal mortality due to fewer seedlings being genetically adapted (Campbell 1975 and 1987). Shorter rotations would also reduce risk.

9. Risk of maladaptation is greatly increased when transferring seed across more than one environmental condition, for example, when transfer is from west to east and also from lower to higher elevation (Adams and Campbell 1982).

10. At both the geographic and elevational limits of a species distribution, natural regeneration should be strongly encouraged (Frank Sorensen, personal communication, March 1995).

11. If ownership or management would benefit by floating the zone boundaries north or south, that usually can be done. Sorensen (1994) stresses that seed zone boundaries do not represent abrupt breaks between populations that have large genetic differences. Instead, zone shapes are chosen to minimize the risk of transfer within their boundaries. The same applies for elevation (*i.e*. a 1000-foot band can be between 1700 and 2700 feet as well as between 2000 and 3000 feet if the former fits the species distribution or land ownership better) with the exception that the bands at higher elevation are often narrower.

12. Local conditions can also affect vigor. If wood production is important and there is a known area within a tree seed zone where growth rates are unusually slow, seed from that area should not be planted on more productive sites even if they are within the same zone and elevation. For example, throughout western Oregon there are many local areas on the east side of high ridges that receive less precipitation than the general area (i.e. they are in a rain shadow). Tree growth in these areas will be less than the growth in the surrounding area and transferring seed from these areas to those with more precipitation may result in reduced growth. This may also be true for the San Juan Islands and the islands in Puget Sound where changes in climate can be abrupt.

13. Relative humidity may be important; for example, transferring seed from a warm, dry area to a cool, moist area may increase the incidence of foliar disease (Nelsen *et al*. 1989).

14. Seed orchard seed is most safely used in the breeding zone of the parents or in the area where the parents have been tested (Campbell 1992).

15. The recommended number of seed parents in a seed lot ranges from 15 to 30. If there is equal representation from each seed parent, then the smaller number is suitable; if there is unequal representation, then the larger number is appropriate (Adams *et al.* 1992). Regardless of the number, the parents should represent a seed zone-wide mix. When specific information about the origin of the seed is maintained, single stand collections are acceptable. This gives the forester the flexibility of combining seed from multiple stands to create a seed zone-wide mix or using mathematical models to determine how far the seed from a single stand can be moved.

16. Small populations of a species separated from the main part of the range may be genetically unusual. If possible, the genetic composition of these populations should be protected by replanting them with seed collected from the isolated population. These populations can also be regenerated naturally. If these options are not practical, seed should be obtained from nearby portions of the main part of the range.

17. Seedlots should be labeled with the most specific information available on collection location and elevation. This will give foresters the most flexibility in using the seed.